Biometric Human Authentication System based on Facial and Fingerprint Templates

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Abstract
Biometric based person identity verification is gaining more and mom attention. It has been shown that combining different biometric modalities enables to achieve better performances than single modality. So, to improve the verification accuracy, this paper combines face and fingerprint for person identity verification. And multimodal biometric fusion strategy based on weighted sum rule (WSR)is evaluated, furthermore, a new method for data normalization in validation system is proposed in this paper. Experiment results prove the effectiveness of fusion of multiple biometrics compared with single biometric, and also the better validation performance by adopting the new data normalization method.

Keywords
Face Verification; Fingerprint Verification; Multi-Biometrics; Fusion Strategy; Weighted Sum Rule

I. Introduction

A biometric person recognition system can be used for two modes: Identification and Verification. In the identification mode, there is no identity claim from the user. The system should decide who the person is. In the verification mode, a person claims a certain identity, the system should accept or reject this claim, (the person is really who he claim to be?) [1]. So, identification mode involves comparing the acquired biometric information against templates corresponding to all the users in the database (one-to-all), the verification mode involves comparison with only those templates corresponding to the claimed identity (one-to-one). In this paper, we focusedon the issue of biometric identity verification. As we know, the identity verification problem is a typically binary classification problem, i.e. template will be accepted or rejected by system [2].

In multimodal biometrics system, the information can be integrated at various levels. Anil K. Jain had given an illustration of three levels of fusion when combining two or more biometric systems in reference [3]. The three levels are: the feature extraction level, the matching score level and the decision level. This paper proposed some fusion algorithms (weighted sum ruleand support vector machine) in the matching score level, and the performance of these algorithms is compared and analyzed [4-7]. The identity verification problem can be formulated as a hypothesis testing problem where the two hypotheses are:

- The person is not from the same identity;
- The person is from the same identity.

For an acquired personal, the verification system should decide the person is an imposter or genuine. The decisions are:

Dl: the person is an imposter;
D2: the person is genuine.
With the hypothesis and decisions above we have:
The false acceptance rate: It is the rate of total number of templates that will be accepted by system.

$$FAR = P\left(\frac{D2}{w1}\right)$$

False rejection rate: It is the rate of total number of templates that will be rejected by system.

$$FRR = p\left(\frac{D1}{w2}\right)$$

Genuine acceptance rate:It is the rate of total number of templates that will be accepted as well as rejected by system.

$$GAR = 1 - FRR,$$

Equal error rate (EER) = 100- (FAR+FRR)
Where,
FAR=FRR
If xIand x2, are the outputs of the component classifiers, then if

$$P(Wi/x1, x2) = max\ P(w/x1, x2), j = 1, 2$$

Were the P (w, /x,nZ) represents the posteriori of w, givenx1, and x2.

II. Face Recognition

To verify the effectiveness (qualities and robustness) of the proposed Face Recognition, we conduct several experiments with this procedure on several images.

The methodology of our proposed work is given below:
Phase 1: Firstly, we develop a code for the loading the face image in the database of the MATLAB. This is done for the loading the face image value in the workspace of the MATLAB.
Phase 2: A code is developed for the correlation method then PCA is used to extract the feature of the image.
Phase 3: After that, Accelerated Binary Particle Swarm Optimization (ABPSO) is executed. We generate the formula of the ABPSO in the MATLAB using the code.
Phase 4: After that, the recognition of the loaded face image is done and a code for the decision on the base of the matching points for the loaded face image is developed. For the matching purpose, we develop the code as shown in fig. 1.

Algorithm 1: File Uploading Method Algorithm
Open File
Get no.of images
For loop for all images
Combine pathname and filename
Read Image
End

Above algorithm is for image uploading algorithm in which image training will be done.

Algorithm 2: Utilization of PCA Algorithm

```
Convert gray scale image.
Apply PCA for feature extraction
DEVimg=mypca(img);
Show image
```

Above algorithm shows the feature extraction algorithm using PCA method in which features obtained will be saved in database.

Algorithm 3: Optimization Algorithm using ABPSO

```
for si=1:r
for s=1:c
Fs=bit_value(si,s);
Ft=mean(bit_value);
calling fitness function
numberOfVariables = 1;
fitval = abpso(FitnessFunction,numberOfVariables);
Fitness Function of ABPSO
{
function [fval] = abpso(FitnessFunction,numberOfVariables)
% range=[xmin xmax ymin ymax zmin zmax];Num_iterations =
15;%<<<----problem exists if more iterations
n = 30; % number of particles
best=zeros(Num_iterations,3);
Start Particle Swarm Optimization
Generating the initial locations of n particles
xrange=range(2)-range(1);
yrange=range(4)-range(3);
xn=(rand(1,n)*xrange+mean(mean(best))+range(1));
yn=(rand(1,n)*yrange+mean(mean(best))+range(3));
[~,fval] = ga(FitnessFunction,numberOfVariables,[]);
```

Above algorithm shows the feature optimization algorithm using ABPSO in which feature reduction of large number of features will be done.

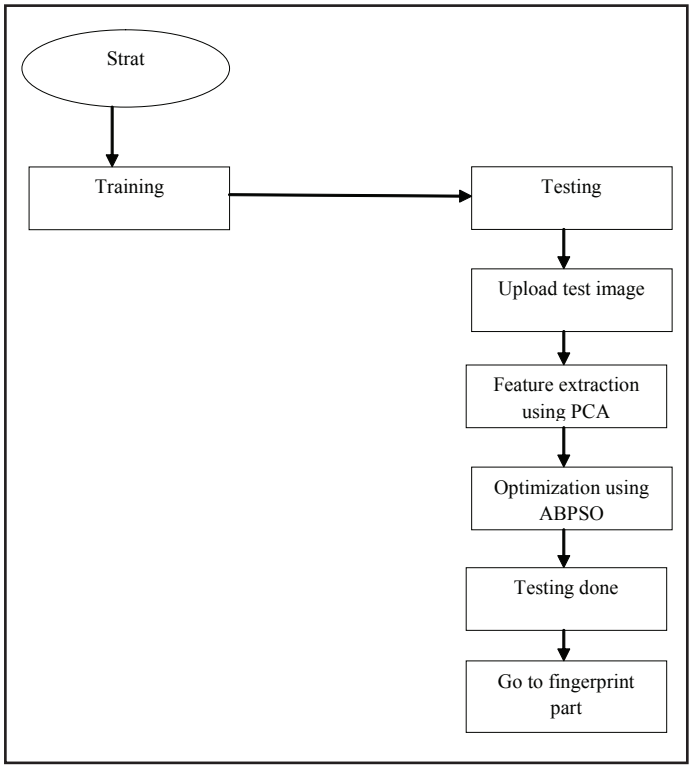

Fig. 1: Face Recognition

III. Fingerprint Recognition

Finger Print authentication system is one of the most common and often used bio metric analysis through which several organizations register the presence of their workers and employees. There are also some organizations in which verification of user is so critical that un authorized access may harm the organization to a great level [8-11]. It has been often seen that the matching procedure is difficult if the finger is tried with the some rotation angle or if the finger print has a little era of margin. Suppose, a user whose data has been stored in the database gets a cut over his finger, a normal matching procedure would deny the access of the user till his finger is not perfectly cure and the matching scenario does not get a perfect scanned centre. This might cause a problem for the organization or the organization might have to take external help to get the user verified through the system. This work presents a verification system which is using Minutia Extraction method as shown in fig. 2.

Algorithm 4: Training Algorithm Using Minutia Extraction

```
main_image =imread(fullpath);
edge_image =edge(main_image,'canny');
load  finger images
Read Input Image
Small region is taken to show output clear
Thinning
Minutiae extraction
 Ridge End Finding
[Rdg_X Rdg_Y]=Find(Ridge==2);
Len=Length(Rdg_X);
Bifurcation Finding
load munitia_features
[rs,cs]=size(munitia_data);
End
```

Above algorithm presents a verification system using Minutia Extraction method in which thinning and ridge finding will also be done

Algorithm 5: Optimization Algorithm using ABPSO

This algorithm will be implemented in the form of algorithm 3.

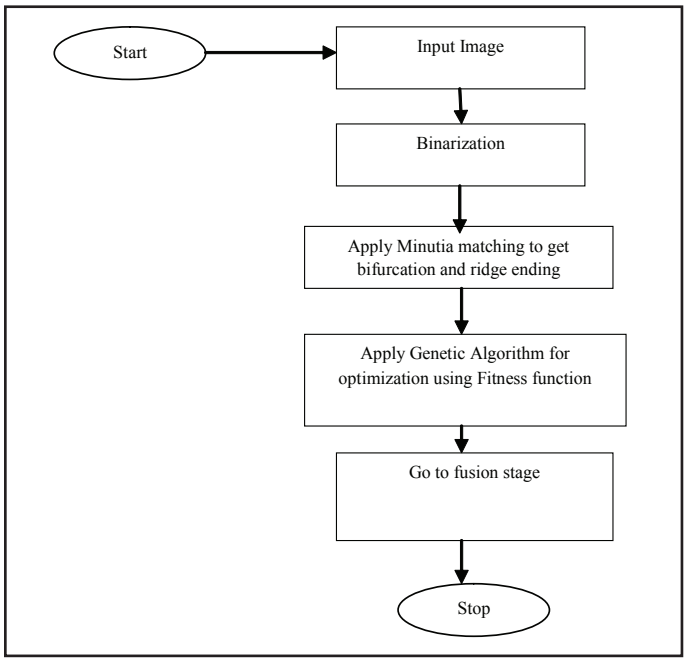

Fig. 2: Fingerprint Recognition

IV. Fusion of Face and Fingerprint Biometrics

As to fusion the face and fingerprint verification system, a match score vector X (x1, x2) represents the scores of multiple verification systems was constructed, where the x1 and x2correspond to the similarity (score) obtained from the face and fingerprint verif. ication system respectively.

A. Weighted Sum Rules

Since, different subjects with different classifiers mayhave different performances. Therefore, it is necessary to usedifferent weight to fuse the component classifiers. Theweighted sum rule is defined as

Assign uq + W, if

$$\sum_{i=1}^{2} WiP\left(\frac{\frac{w}{x1}}{x2}\right)$$

Where I is the individual verification system, w. is theweight assign to classifier I and can be calculated by the following formulates.

$$W1 = 1 - \frac{2E1}{2 - 2(El + E2)},$$

$$w2 = 1 - 2E2/\,2 - 2(E1 + E2)$$

Where El and E, is the EER of face and fingerprintverification system

V. Results and Analysis

The whole simulation will be done in MATLAB environment 2010a. The recreation of knowledge on the diverse area of multimodal biometric systems shows the importance of multimodal biometric system to provide strong authentication. The summary of the study shows that of the multimodal system is having edge over other biometric traits. Table 1 depicts performance comparison of different biometric technologies based on parameters like accuracy, FAR and FRR.

A. Calculate FAR

Total Number of Samples in the database=

Number of Sample that falsely accepted=

FAR=Total Number of Samples-Number of Samples that falsely accepted

Total Number of Samples

B. Calculate FRR

Total Number of Samples in the database=

Number of Sample that falsely accepted=

FRR=Total Number of Samples-Number of Samples that Falsely Rejected

Total Number of Samples

C. Calculate Accuracy

Accuracy=100- (FAR+FRR) %

Table 1: Comparison Table

S.no	FAR	FRR	Accuracy
1	1.99	.841	97.15
2	1.98	.983	97.35
3	1.97	.845	97.44
4	1.96	.845	97.33
5	1.99	.85	97.67
6	1.992	.851	97.67
7	1.993	.843	97.89
8	1.981	.843	97.78
9	1.965	.832	97.8
10	1.981	.822	97.44

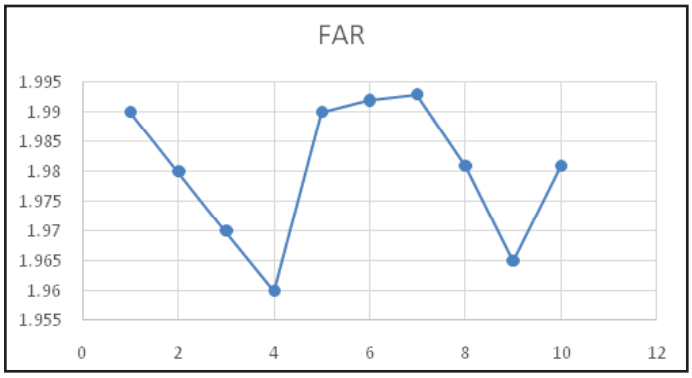

Fig. 3: FAR Result Evaluation

FAR=Total Number of Illustrations-Number of Illustrations that falsely accepted/ Total Number of Illustrations.It is defined as the measure that wrongly accepts an effort by an unauthorized user.

Its value must be low in order to get good accuracy system. For proposed work its values lies between 1.991 to 1.997.

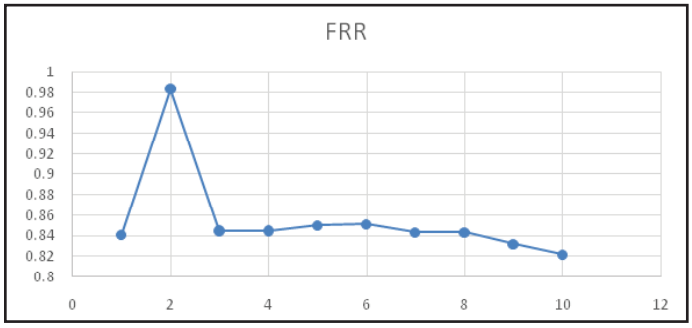

Fig. 4: FRR Result Evaluation

FRR=Total Number of Illustrations-Number of Illustrations that Falsely Rejected/ Total Number of Illustrations.It is defined as the computation that incorrectly rejects an access effort by an authorized user.

Its value must be low in order to get good accuracy system. For proposed work it's values lies between .82 to .89.

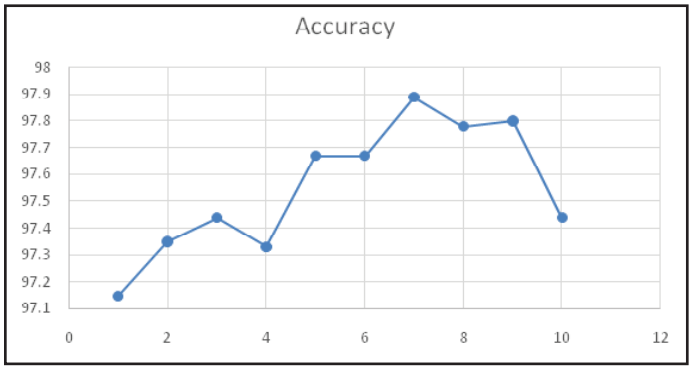

Fig. 5: Accuracy Result Evaluation

The utilized method is proposed viable and effective structure for taking in a versatile online ravenous inadequate direct discriminant examination model for face and finger print acknowledgment having accuracy = 97%.

VI. Conclusion

It is our opinion that research in face and fingerprint multimodal recognition is an exciting area for many years to come and will keep many scientists and engineers busy. In this proposal, we have given concepts of face recognition methods as well fingerprint recognition methods for fusion.

Also, a model of face acknowledgment System utilizing PCA and ABPSO method has been developed along with fingerprint recognition method based on minutia extraction and ABPSO method. Here, a static multimodal acknowledgment framework has been created using weighted sum rule method. Firstly, various pictures has been taken and afterward highlight extraction is done in which expansive number of highlights has been extricated. After that acceptance check has been executed utilizing weighted sum rule methodas a part of which exactness has been gotten of 97%.

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